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Greenhouse Gas Offset Programs for Bates Study Abroad Air Travel

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EXECUTIVE SUMMARY

In 2009, Bates College joined the American College and President's Climate Commitment (ACUPCC), a national initiative focused on collective sustainability and climate action within higher education. In 2010, according to the requirements set by the ACUPCC, Bates pledged to achieve climate neutrality by 2020 by reducing energy consumption, increasing campus energy consciousness, and converting to renewable energy. However, the college will not be able to meets its goal by these methods alone. Currently, over 60% of Bates students study abroad, and the cumulative greenhouse gas (GHG) emissions associated with these travels are not currently included in Bates' accounting of GHG emissions. Detailed calculations show that these emissions, comprised of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), are substantial - too much for further use of business as usual emission reduction methods to compensate for. Thus it is time that the college purchase offsets, which is the anticipated last step toward carbon neutrality. We have identified several offset projects in Maine, all of which meet required verification standards. However it is imperative that Bates also invest in local projects to enhance its personal educational and research opportunities. We suggest a budget protocol that would allow the college to couple verified offsets with local projects to satisfy requirements set out by the ACUPCC, the Climate Action Plan and goals set forth by the College's Mission Statement. In addition, we recommend that the Office of Sustainability and the Center for Global Education further collaborate with other higher education institutions toward a peer verification system that allow for increased local engagement for the purpose of offset programs.

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1. INTRODUCTION

In 2010, after signing on to the American College and University Presidents' Climate Commitment (ACUPCC), Bates College set out a goal to achieve carbon neutrality by 2020. While the gap between GHG emissions and neutrality has been significantly decreased by emissions reductions, increased energy efficiency and increased awareness of sustainability on campus, Bates still has a substantial amount of emissions to reduce over the next few years to reach neutrality. Currently, emissions resulting from Bates-associated travel, including student study abroad programs, are not included in Bates College's total carbon footprint. This project is part of a larger proposal to quantify the amount of GHGs being emitted as a result of Bates students, faculty, and administration travelling to and from the college, known as Scope III emissions, and to explore the mitigation strategies that would most effectively reduce the environmental impact of this travel (Tom Twist, personal communication, Sept. 21, 2017).

The primary goal of this project was to further Bates College's goal of carbon neutrality through the quantification of GHG emissions from student study abroad travel. Another major aim of this project is to propose a variety of verified offset projects and localized programs that will benefit both Bates and the greater Lewiston/Auburn community. Verified projects are necessary for aiding the college in reaching carbon neutrality, and assisting Tom Twist, the Sustainability Manager at Bates, in brainstorming options for emissions reductions and mitigation. On the other hand, local projects also have great potential for bettering the relationship between Bates and the Lewiston/Auburn community, and creating sustainable development opportunities for local residents. Most offset programs rely on distant projects, often in other countries and continents, to reduce emissions. However, this project is not solely about becoming carbon neutral, it's also about the strategies Bates uses to reach this goal, which have the potential to benefit the community on many different levels. Accordingly, it is important for Bates to invest in offset programs directly in the greater community with the aim of improving the health, wellbeing, and sustainability of Lewiston/Auburn residents and communities, as opposed to investing in distant programs which we may never see the result of.

2. METHODOLOGY

2.1 Flight Emissions Quantification

The first step of this project was the quantification of GHG emissions associated with Bates study abroad travel. To do so, we obtained study abroad travel data for the 2016 - 2017 academic year from David Das in the Bates Center for Global Education. This data covered travel to and from the host country of each student or program, but not additional travel that students might have done. Using coefficients from the US Environmental Protection Agency (EPA) Emission Factors (Table 1), we calculated the total amount of CO_2, CH_4, and N_2O resulting from student study abroad air travel and staff site visits (Emission Factors, 2014). The length of each flight was calculated from Boston Logan International Airport in Boston, MA and multiplied by two to obtain a round trip distance. To compare the climate impact of each of these GHGs on institutional, national and international scales, all GHG totals were converted to metric tons CO_2e, and then added up to determine a "toeprint" total emissions for study abroad travel.

	kg CO_2 / passenger - mile	**g CH_4 / passenger - mile**	**g N_2O / passenger - mile**
Emission Factors	0.191	0.0008	0.0060

Table 1 *EPA Emission Factors used to calculate GHG emissions for Bates study abroad air travel. See Appendix A for detailed calculations (Emission Factors*, 2014*).*

In addition to calculating round trip flights for all students, this study attempted to quantify per-passenger emissions from ground service vehicles at Boston Logan Airport. The data required for a more accurate calculation was far beyond the scope of this project, however, using modeled results from Northeast States for Coordinated Air Use Management (NESCAUM) and data from MassPort, we were able to obtain sufficient data for an estimate (Park, 2001; *Airport Statistics*, 2017).

2.2 Foundational Research

To assess the framework and priorities of a Bates GHG offset program, we reviewed scholarly literature and reports by the ACUPCC and other voluntary offset programs, consulted with Bates staff and Lewiston/Auburn residents, and contacted several peer institutions. Our research, which has been compiled within a separate document as a literature review, summarizes the history of offset initiatives on the global scale, examines critiques of offset programs, and outlines the standards that offset programs must meet to count as a program.

Information provided by this research helped us establish specific requirements for a Bates offset program, and gave us ideas for incorporating local projects. Through discussions with Tom Twist, Tina Mangieri, and David Das, we gained insight into Bates' environmental, educational, and financial priorities. Likewise, we consulted with Shanna Cox, the founder of Healthy Neighborhoods, to gain an understanding of Lewiston and Auburn's sustainable and economic goals. We also conferred with peer institutions that are working towards similar climate goals or that have well established offset programs, such as Duke University, College of the Atlantic, the University of New England, and Unity College. Their advice and prior experience with the establishment of offset programs guided the structure and project requirements of our own offset program. Their suggestions also led us to a variety of third party verified projects and local projects that were incorporated into our recommendations.

2.3 Valuation of Third Party Verified Offset Programs

To compare the offset potential and overall effectiveness of each verified project, we established three metrics (Figure 1), scored each project according to the metrics, and then weighted certain metrics over others according to the priorities of Bates and the Lewiston/Auburn community, respectively.

Verified Project Quantification Scale
Cost 1 - Above $15 per carbon credit 2 - Between $10 and $15 per carbon credit 3 - Below $10 per credit **Location** 0 - Project is outside New England 1 - Offset projects are based outside of Maine but are still in New England 2 - Offset projects are located in Maine 3 - Offset projects are located in the Lewiston/Auburn community **Co-Benefits** 1 - Projects provide environmental co-benefits, but no economic and/or social co-benefits 2 - Projects provide environmental and economic, and/or social co-benefits

Figure 1 *Metrics used to compare and assign value to third party verified offset projects.*

Each project was scored according to its cost, location, and the environmental, economic and/or social benefits it could provide to Bates and the greater Lewiston/Auburn community. Cost was ranked on a scale from 1-3, with 1 being the least desirable result and 3 being the most desirable result. Location was ranked on a scale from 0 to 3, with 0 as the least desirable result and 3 as the most desirable result. This was the only variable in the verified project metric that allowed projects to score a "0," as it allows us to prioritize more local offsets (ie, within Maine or New England) over non-local offsets. Finally, the degree of co-benefits provided by each project was ranked on a scale from 1 to 2, with 1 as the least desirable result and 2 as the most desirable result.

To evaluate how each project compares to each other in terms of offset effectiveness, we weighed each one according to the priorities of Bates and the Lewiston/Auburn community, using the model we created. As Figure 2 below illustrates, the concerns of each group are distinct, however the prioritization of locality is shared by Bates and the community.

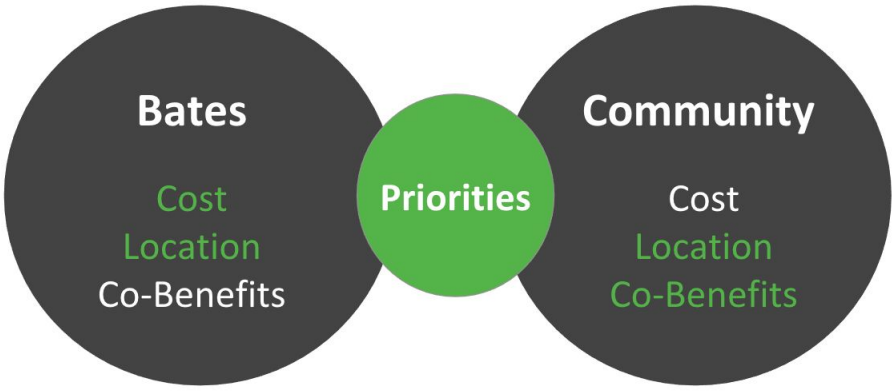

Figure 2 *Priorities of Bates and the Lewiston/Auburn community are shown in green. These metrics were weighted threefold over the one shown in white in each priority scenario.*

These priorities were established through consultations with Tom Twist and Shanna Cox. As Tom Twist emphasized, Bates is most concerned with the mitigation of emissions associated with the college in a time sensitive manner. However, the location of verified offset programs is also important to Bates, as encapsulated by the college's mission statement and its commitment to engagement and service beyond the campus boundaries. On the other hand, Shanna Cox stressed that Lewiston/Auburn residents would be more concerned with their direct benefits from a Bates offset program. Accordingly, the location and the co-benefits provided by each offset are more important to the Lewiston/Auburn community than the cost and overall climate mitigation potential provided.

All projects were given a score for each metric (ie. a 2 for cost). Since each metric will be weighted, the scores were transformed into a fraction rather than their original raw score (ie. a ⅔ for cost), therefore neutralizing metrics that had different scales. Next, each score was weighted, according to both Bates and the Lewiston/Auburn community's priorities. For the Bates scenario, cost and location were weighted threefold over co-benefits, while location and co-benefits were weighted threefold over cost for the community scenario.

2.4 Valuation of Local Projects

We established four metrics, described below, as part of a separate model used to evaluate the co-benefit potential and overall effectiveness of each local project.

Local Project Quantification Scale
Education 0 - Projects do not provide any educational opportunities for Lewiston/Auburn residents and Bates students 1 - Projects have the potential for educational partnerships with Bates through independent research or internships 2 - Projects provide educational opportunities for both Lewiston/Auburn residents and Bates students **Economic** 0 - Projects do not provide any economic benefit to Lewiston/Auburn residents 1 - Projects provide direct monetary benefits to Lewiston/Auburn residents **Social/Partnerships** 0 - Bates and Lewiston/Auburn residents do not interact at all over the course of the project 1 - Bates and Lewiston/Auburn residents interact throughout the duration of the project 2 - Bates and Lewiston/Auburn residents establish partnerships that extend beyond the duration of the project **Ecosystem Services** 0 - Projects do not provide any ecosystem services 1 - Projects provide ecosystem services

Figure 3 *Metrics used to compare and value local projects.*

Each project was scored according to the educational and social/partnership opportunities they could provide to Bates and the Lewiston/Auburn community, and whether or not they provide economic benefits and/or ecosystem services to Lewiston/Auburn residents. The degree of educational and social/partnership opportunities was scored on a scale from 0 to 2, with 0 as the least desirable result and 2 as the most desirable result. The economic and ecosystem service potential of each project was ranked on a yes/no scale of 1 or 0, with 0 as the least desirable result and 1 as the most desirable result. A simplified yes/no scale was used for these two

variables because they are especially challenging to quantify. Accordingly, it made sense to simply determine whether or not projects could provide economic or ecosystem service benefits. For the purposes of this paper, ecosystem services or goods are "the benefits human populations derive, directly or indirectly, from ecosystem functions (Constanza et al. 1997).

2.5 Budget Recommendations

Using financial recommendations by the Center for Global Education and the Office of Sustainability, we proposed several budget schemes through which Bates could offset all emissions associated with study abroad and meet the ACUPCC's requirements for an offset program. Budget sources from on campus resources and students input were investigated for their potential to finance offset programs.

2.6 Presentation of a Final Report

We presented our research, offset programs, metrics and budget recommendations to several Bates community members with stakes in our offset program. These community members included Sam Boss from the Harward Center, Francis Eanes and Holly Ewing from the Bates Environmental Studies Department, Tina Mangieri from the Center for Global Education and Tom Twist from the Office of Sustainability. Their questions and input helped guide and refine our final report.

3. RESULTS AND DISCUSSION

3.1 Quantification of Greenhouse Gas Emissions

Using data collected by the Bates Center for Global Education, a "toeprint" GHG emissions total of 691 metric tons of CO_2e was calculated for study abroad travel during the 2016 - 2017 academic year. We consider this total a "toeprint" because it only covers emissions associated with student travel to and from their host study abroad country, and an initial number for emissions associated with ground service equipment at the airports that students travel to and from. A more accurate GHG emissions total would also incorporate student travel while abroad, which would include additional flights, train rides, bus rides, and car travel.

As illustrated in Table 2, the total metric tons of CO_2, CH_4 and N_2O emitted by each group associated with study abroad was calculated and converted into metric tons of CO_2e. Students studying abroad for the Fall 2016 semester were responsible for a total of 244.4 metrics tons of CO_2e while travelling to and from their study abroad locations (Figure 4), students studying abroad during the Winter 2017 semester were responsible for a total of 282.4 tons CO_2e, and students who studied abroad for the full academic year were responsible for 6.5 tons CO_2e. Furthermore, students and professors who studied abroad for the 2017 Short Term were responsible for 149.3 metric tons CO_2e, while travel by study abroad staff resulted in 8.5 metric tons of CO_2e.

The resulting emissions totals from ground service vehicles were insignificant, a total of .32 tons for the academic year, and thus they did not have a major impact on the final emissions calculations and were not included in the final emissions totals.

	CO_2 (metric tons)	CH_4 (kg)	N_2O (kg)	Total CO_2e (metric tons)
Fall 2016	242.10	1.02	7.62	244.39
Winter 2017	279.76	1.17	8.79	282.41
Full Year	6.47	0.03	0.20	6.53
Short Term 2017	147.88	0.81	4.65	149.28
Staff Travel	8.45	0.04	0.25	8.53

Table 2 *Total emissions summary by travel time. Three GHGs were incorporated into these calculations. Their individual contributions are shown above.*

Emissions stemming from study abroad travel constitute around 10% of Bates' total on and off campus emissions for the 2016 - 2017 academic year (Figure 4). Again, our calculation of study abroad associated GHG emissions is still an initial calculation, meaning that once additional emissions are factored in, these emissions will most likely constitute a greater percentage of Bates' total emissions

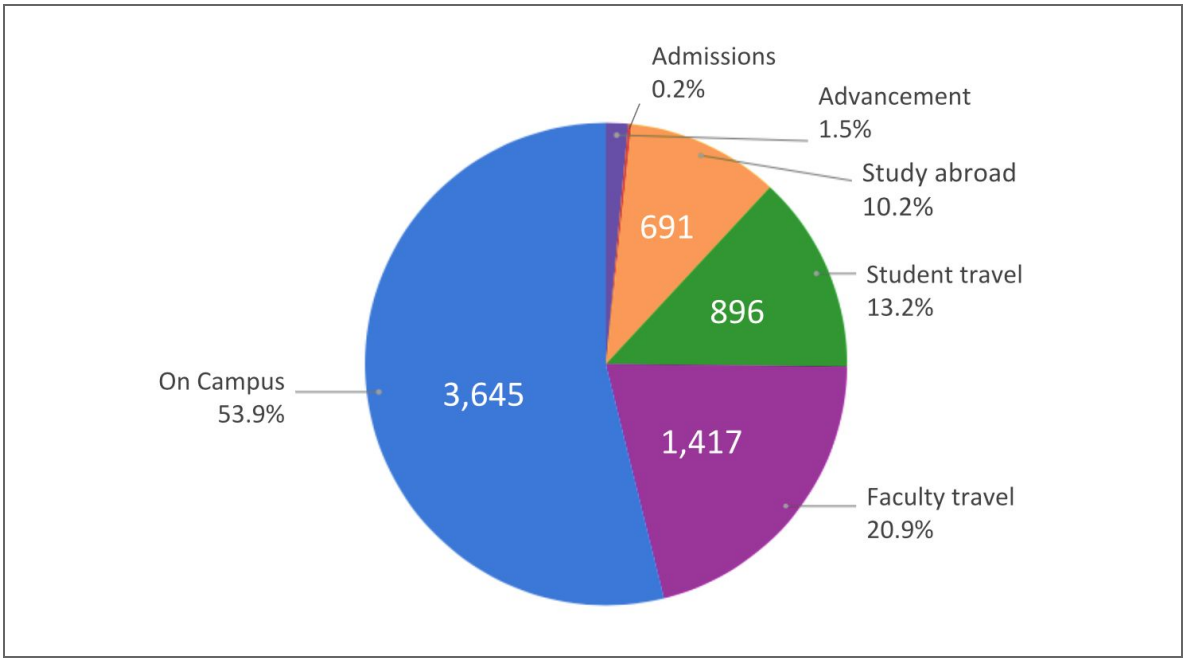

Figure 4 *Bates 2016 - 2017 total on and off campus emissions (metric tons CO_2e). Notice that study abroad emissions represent about 10% of Bates' total emissions.*

Figure 4 also illustrates that study abroad associated emissions form a significant portion of Bates' total emissions. These emissions are much harder to avoid, or reduce through strategies such as energy efficiency, compared to on campus emissions. The study abroad experience is regarded by many Bates staff, professors and students as a key experience during one's time at Bates, and is recommended to most students. As a result, it is unlikely that study abroad participation will decrease for future academic years. Likewise, unless energy efficiency and renewable energy solutions emerge for air travel within the next decade, it is also unlikely that GHG emissions from air travel will be significantly reduced in future years. This validates the importance of an offset program to compensate for study abroad emissions, as it is improbable that emissions reductions could occur through avoidance of travel or direct reductions of travel emissions, at least for the coming decade.

3.2 Offset Program Framework

The ACUPCC defines a carbon or GHG offset as "a reduction or removal of carbon dioxide equivalent GHG emissions that is used to counterbalance or compensate for emissions from other activities" (Dautremont-Smith et al. 2009). Although the ACUPCC has not required college or university offset programs to meet a specific carbon offset standard, projects must meet a third party verified standard to count as an emissions reduction for the institution. Furthermore, colleges and universities must ensure that projects meet the following standards, which are are typical for most voluntary carbon offset programs:

- **Permanence** - Emissions reductions must be irreversible. GHGs cannot be re-emitted into the atmosphere by a set point in the future
- **Real** - Offset projects must result in measurable emissions reductions
- **Additionality** - Offset projects must result in emission reductions above and beyond those that would have already taken place at the institution
- **Verified** - Projects must be reviewed and legitimized by an independent third party auditor

- **Synchronous** - Emissions reductions occurring through an offset project must take place soon after the emissions being offset were emitted
- **Transparency** - Colleges/universities must make the details of each offset project and emissions quantifications available to institutional stakeholders or those with an interest in the offset program
- **Registered Projects** - All offsets must be registered with a well-known carbon registry

Based upon these guidelines, we researched a third party verified projects through a variety of carbon brokers. All offset projects offered through carbon brokers have been reviewed according to the above standards. They have also been verified and registered within offset registries, meaning that they meet the requirements set by the ACUPCC. We were directed to several carbon brokers and projects by peer institutions, based upon their own experiences with these programs or their work in establishing certain projects. For example, Duke has collaborated for many years with the Urban Offsets program to establish offset projects that benefit both Urban Offsets and Duke.

3.3 Third Party Verified Offset Descriptions

Both Tom Twist and Shanna Cox emphasized the importance of local offsets. Accordingly, we prioritized offsets located within Maine and New England. All verified offsets identified were either Improved Forest Management (IMF) or landfill capture projects, which capture methane in landfills and direct it over an open flame. This process converts methane into a less potent GHG before releasing it. Furthermore, some landfill capture projects use heat from combustion to produce energy. The following projects are all listed on the Climate Action Reserve (http://www.climateactionreserve.org) and thus they follow a detailed verification process approved by California's Air Resource Board (ARB), as a part of the state's goal to reduce GHG emissions to 1990 levels by 2020. This legislation created a cap and trade program and an offset compliance program, both of which drive the US carbon market (California Air Resources Board, n.d.; Climate Action Reserve, n.d.).

Although these markets and verification standards originate in California, they can be applied in the northeast as well, despite differences in land ownership and regulations. Such regulations include high up-front developments costs, unstable markets, and uncertain long term monitoring costs (Kerchner & Keeton, 2015). Despite these barriers, we have described several projects, some of which involve private landowners, and others involving land trusts and indigenous communities. The following sections provide detailed descriptions of third party verified projects, separated by carbon broker, that have been found in the region.

Finite Carbon

Finite Carbon is a carbon broker based in Pennsylvania. They have several available projects, including a partnership with the Passamaquody Tribe in Pleasant Point, ME, which is the first Native American Carbon Project on the Eastern US. This particular offset is an IFM project in which the Tribe agreed to additional monitoring and verification standards on their 98,000 acres to comply with guidelines dictated by the state of California (C. Hinton, pers. comm. Dec. 7, 2017). Chief Clayton Cleaves stated that the project allows the tribe to protect natural resources and creates unique employment opportunities (Passamaquody Tribe Partners, 2014). Unfortunately, the majority of credits are sold through arrangements made with companies in California who are mandated to offset their emissions, thus the project is not designed for voluntary purchases (C. Hinton, pers. comm. Dec. 7, 2017). There are credits remaining, however, and since Bates has a small demand, this project could be suitable. Corey Hinton (mchinton@dwmlaw.com) is excited about Bates' interest in purchasing offsets and is an excellent contact person for this project to determine the how many credits are available when the purchasing process begins.

Location of Offset: Pleasant Point, ME
Project Type: IFM
Price per metric ton CO_2e: $12 - $13
Co-Benefits: This offset project invests in a Native American tribe, which has historically been pushed off its land and forced to assimilate to white American culture. By buying into this project, the 98,000 acres has a better chance of staying in Passamaquody Tribe hands and the Passamaquody Tribe people have a new source of income. The social and economic benefits for indigenous peoples are what make this project unique and worth considering for Bates. Of course there are environmental co-benefits as well, including improved air quality and a potential for improved habitats.

The Climate Trust

The Climate Trust (https://climatetrust.org) has actively worked on several projects in Maine already including the Farm Cove Community Forest in Grand Lake Stream, which is a 33,709 acre plot of land owned by the Downeast Lakes Land Trust. The project is at or near completion, with the final outcome being a forest containing a mix of younger and more mature stands of several species (The Climate Trust, 2017). This was accomplished through understory management to limit nutrient competition, monitoring of pests, and increased stock. The Climate Trust is currently working on a project for the AMC Katahdin Iron Works 10,000 acre ecological reserve in Dover-Foxcroft that has a mission to preserve the forests sequestered carbon through similar methods. This project has several co-benefits including improved soil health, water quality, and preservation of land threatened by timber harvest (Burbank, 2014).

The Climate Trust sell carbon credits for ~$10 per credit, however they are currently under the verification process for the aforementioned projects and it is unclear whether there will be carbon credits available for purchase in 2018. However if there are, Bates would not be able to offset the entirety of its study abroad emissions through projects in Maine with this broker. Sheldon Zakreski (szakreski@climatetrust.org) of The Climate Trust is interested in maintaining contact with Bates for further communication in regards to projects outside Maine if the credits from AMC Katahdin Iron Works and the Farm Cove Community are exhausted.

Location of Offset: Dover-Foxcroft, ME
Project Type: IFM
Price per metric ton CO_2e: $10
Co-Benefits: This project does not have any direct social or economic benefits. The primary co-benefits are environmental - improved air quality, pest management, conserved land, etc.

The Climate Trust also offered a landfill capture project in Connecticut, however this project was terminated after one year due to a lack of monitoring and continuation of verification protocol (Climate Action Reserve, n.d.). In the one year that it ran, methane was captured, burned, and converted to usable energy. Colby College purchased offsets from this project in 2013, thus it would be a suitable option for Bates if it operations commence again at a later date (Colby Sustainability Report, 2013). This project is one of several other projects overseen by the Climate Trust, however it also shows the complexity of the verification process and highlights flaws in offset standards.

Location of Offset: Windsor, CT
Project Type: Landfill capture
Price per metric ton CO_2e: $10
Co-Benefits: This landfill project improved air and groundwater quality, reduced odor, and produced renewable energy.

Terrapass

Terrapass manages the only current landfill capture project in Northern Maine. The landfill opened in 1977 and is used by three neighboring towns - Fort Fairfield, Caribou, and Limestone. This project will construct 26 wells to capture methane and direct it over an open flame to prevent methane from directly entering the atmosphere. In this case, the energy from burning is lost as heat, however other projects produce usable energy.

Location of Offset: Fort Fairfield, ME
Project Type: Landfill capture
Price per metric ton CO_2e: $11
Co-Benefits: In addition to reducing GHG emissions, methane capture improves local air and groundwater quality and reduces odor.

Northeast Wilderness Trust

The Northeast Wilderness Trust is working to simultaneously reduce their carbon footprint while capturing additional carbon by preserving woodlands, which they believe sequester a greater volume of carbon than forests managed for logging ("Mitigation / Wild Carbon", n.d.; Nunery & Keeton, 2010). They accomplish their second goal by collaborating with landowners to sell verified carbon credits from their land. Working directly with landowners is an excellent way to create offset projects in a region where much of the land is developed and/or privately owned. Interested landowners must demonstrate that they will avoid converting their forest to another use at a future date and that they will properly manage their land. This company has two projects listed on the Climate Action Reserve, the 500-acre Howland Research Forest and the 1,500-acre Alder Stream Preserve, both of which meet all necessary verification criteria. In addition to these two projects in Maine, the Northeast Wilderness Trust has several other location throughout New England, and some in upstate New York ("Mitigation / Wild Carbon", n.d.).

Location of Offset: Atkinson, ME
Project type: IFM
Price per metric ton CO_2e: Not listed on broker website
Co-Benefits: Northeast Wilderness Trust projects conserve numerous habitats, improve air and groundwater quality, and in some cases provide recreational opportunities.

Urban Offsets

Urban Offsets (http://urbanoffsets.co) offers a pre-bundled offset package that pairs a local tree planting with a third party verified offset registered through the Climate Action Reserve. It is important to note that since they are a relatively new company, tree plantings are only offered in New York City, Atlanta, Phoenix, Tempe, Charlotte, Durham, Greensboro, St Louis, and Fayetteville, however more locations are coming soon. The closest location to Bates would be in New York, thus the local benefits are lost. Urban Offsets does however offer a very cheap price per credit of $8 for their New York Project and $10 for others further south ("How It Works", 2016)

Urban Offsets was founded in partnership with Duke University, thus they are used by the University as part of their bundling program. Duke gets both benefits of the program - third party verified offsets and an investment in a local innovative project at a very low price to the university. College of the Atlantic has also expressed interest in using Urban Offsets for future purchases although they would be unable to get a local tree planting (A. Russell, pers. comm. Oct. 11, 2017) . There is potential for Bates and College of the Atlantic to leverage their interest and encourage Urban Offsets to expand to Maine.

Location of Offset: New York, NY
Project type: IFM coupled with "local" tree planting
Price per metric ton CO_2e: $8-10
Co-Benefits: Local tree plantings can have tremendous social co-benefits. They increase city green space and create small habitats for city birds. Furthermore, they provide a space for community planting opportunities that unite residents. Although the carbon sequestering potential for urban trees is low, they can help to improve air quality.

3.4 Third Party Verified Offset Project Valuation Results

As illustrated below in Table 3, each of the seven verified offset projects reviewed in this report were scored according to the metric detailed within our methods.

	Finite Carbon	**Climate Trust (IFM)**	**Climate Trust (Landfill)**	**Terra-pass**	**Northeast Wilderness Trust**	**Urban Offsets**
Cost						
Location						
Co-Benefits						

Table 3 *Unweighted scores for the seven verified offset projects according to the three metrics described in the previous section.*

The majority of projects cost between $10 - $15 and were given a score of 2 for cost. Two projects, Terrapass and Urban Offsets, cost below $10 per carbon credit and were given a score for cost of 3. The prices per carbon credit were not listed on the Northeast Wilderness Trust so these projects were not given a score for the cost variable.

Likewise, most of the verified projects are located in Maine, and were thus given a score of 2 for location. The two exceptions were the Climate Trust Landfill Capture project, which is located in Connecticut, and the nearest Urban Offsets project, which is located in New York. Because the Climate Trust project is still located in New England, it scored a 1, while the Urban Offsets projects was given a 0 for location because it is based outside of New England.

Finally, most of the offset projects provided social and/or economic co-benefits, in addition to environmental co-benefits, and were accordingly given a score of 2 for co-benefits. Based upon

conversations with carbon broker representatives and internet research, the Climate Trust IFM and Northeast Wilderness Trust projects only seem to provide environmental co-benefits. They were thus given scores of 1 for co-benefits offered. Again, note that these scores were ultimately recorded as a fraction of the total possible points for each metric.

Once each verified project was scored according to the metric, we weighed some variables over others, according to the priorities of Bates and the Lewiston/Auburn community. For the Bates scenario, cost and location were weighted threefold over the co-benefits provided by each project, while co-benefits and location were weighted threefold over cost for the Lewiston/Auburn community. As Figure 5 below demonstrates, this ranking and weighting system allows us to compare the overall value and effective of each verified project.

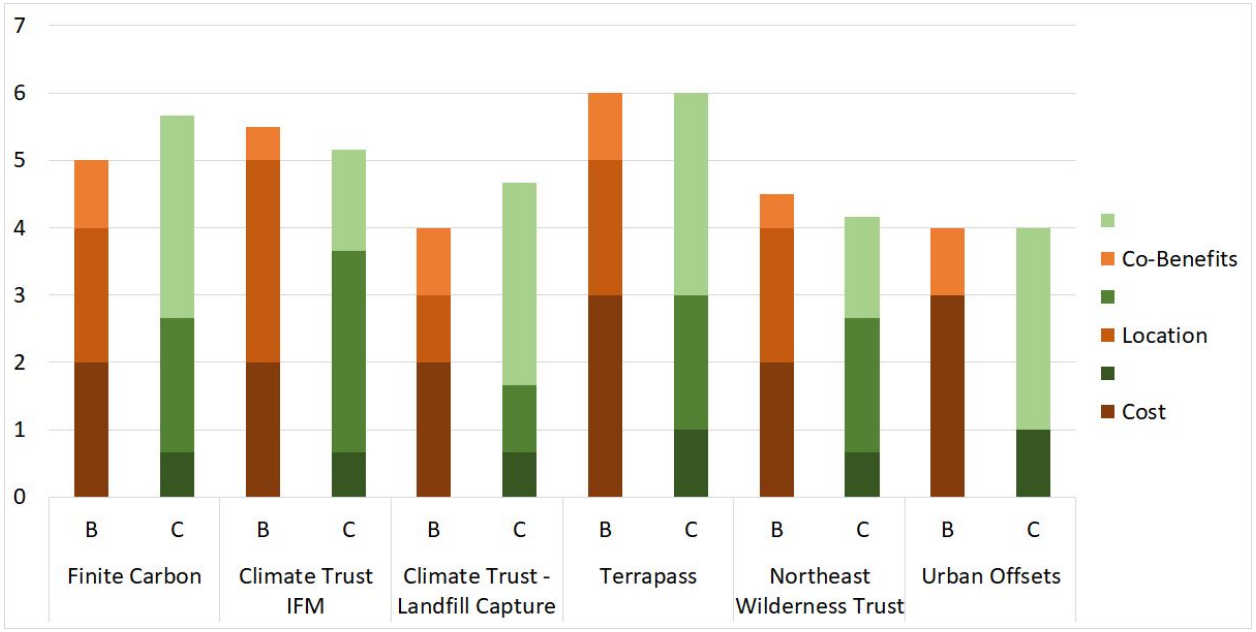

Figure 5 *Ranking and weighting of each verified offset project according to the priorities of Bates (B) and the Lewiston/Auburn community (C)*

Once weighed according to Bates' and the Lewiston/Auburn community's priorities for an offset program, all of the projects fell within a similar range of scores. However, because both Bates and Lewiston/Auburn regard the "localness" of offset projects as one of the most important elements of an offset program, the projects closest to Bates ended up scoring higher than projects

further away from Bates. This further supports that these local or Maine-based projects should be prioritized over projects outside of Maine within a future Bates offset program. Likewise, the scores according to Bates and the Lewiston/Auburn community's priorities were very close, if not the same, for all projects, which further emphasizes the overlapping interests of these two groups.

According to this metric, the Terrapass landfill capture project scored the highest for both Bates and the community, due to its low cost, location in Maine, and its potential to provide environmental, economic and/or social co-benefits. The Finite Carbon IFM offsets, and Climate Trust IFM offsets scored very closely behind the Terrapass project. These high scores were again the result of the relatively low cost of each of these projects, their locations in Maine, and their co-benefit potential.

Even though the Urban Offsets IFM project has a very low cost and provides a high degree of co-benefits, it ranked the lowest out of all the projects for both Bates and the Lewiston/Auburn community. This is mainly because the Urban Offsets projects are not located in New England, meaning that they didn't even receive a score for the location variable. It's also worth noting that even though these projects do provide great co-benefits, no one at Bates or in Maine/New England would benefit from these projects.

3.5 An Argument for the Inclusion of Local Projects

Although only third party verified offsets can officially count towards climate neutrality for Bates, it is also important for the offset program to include projects that have educational, environmental, and economic benefits beyond emissions reductions for both Bates and the greater Lewiston/Auburn community. The ACUPCC asserts this multiple times in its guidelines, and advocates that "it is in the interest of said institutions to ensure that carbon offset projects add value to their education, research, and service missions," and that "projects should also have other social, environmental, and economic co-benefits" (Voluntary Carbon Offset Protocol,

2008). In its own 2010 Climate Action Plan, Bates further emphasized the importance of student and community involvement in offset programs, and wrote that "the development of local offset projects…[is] an opportunity for environmental education and community outreach — two of Bates' strengths" (Cowan et al., 2010). After all, as dictated in the Mission Statement of the College, "informed civic action" and "commitment to responsible stewardship of the wider world" are at the core of the Bates experience (Mission and Outlook, n.d.).

Currently, local projects would not be able to count towards emissions reductions for Bates, as they are not officially verified and would most likely not meet many of the standards required by the ACUPCC. However, this does not mean that the projects still shouldn't be financially invested in. While these projects will not offset as much CO_2e as verified projects and are usually much more expensive per ton of CO_2e, they will benefit students and Lewiston/Auburn residents to a much greater degree.

It is also very likely that with current financial and time-based investment, non-verified, local offsets could eventually be verified through a peer institution verification program. The verification process is quite expensive, and must be conducted every few years or so to maintain the project's legitimacy. This is a huge deterrent towards making local projects more official, especially for small institutions such as Bates. Through conversations with Duke and College of the Atlantic, we discovered that they also found the verification process to be an roadblock in backing local projects. In response to this issue, Duke is developing a peer verification system through which institutions with offset programs would take turns evaluating and verifying each other's local offset projects. As a result, these projects could still meet the official standard, without the costly price tag of bringing in an outside consultant. This program is still in development, but several other institutions, including CoA have expressed a high degree of interest. When it is launched, Duke's peer verification program has the potential to increase the engagement of Bates students within the Lewiston/Auburn community, expand environmental research and internship opportunities, and have even greater economic, educational and environmental benefits for the Lewiston/Auburn community.

3.6 Local Project Descriptions

There are several possible offset projects in Lewiston/Auburn, some pre-existing, others not. The following sections describe several options for establishing and strengthening partnerships and opportunities for investing in the local community.

Local Gardens

In 1999, the Lots to Gardens program was founded in partnership with the St. Mary's Nutrition Center. Since then, over a dozen vacant lots in Lewiston/Auburn have been converted to community gardens that benefit local residents and youth (St. Mary's Nutrition Center, n.d.). Bates is also interested in garden space, as there are several students who work with the St. Mary's Nutrition Center who have expressed interest in having an on-campus garden. In addition, St. Mary's is eager for more garden space in Lewiston/Auburn. Therefore, there is an opportunity for Bates to assist in funding a garden for use by both Bates students and community members.

Three Bates students, Dacota Griffin, Joe Tulip, and Noah Morasch, have identified 29 vacant lots in Lewiston/Auburn (see Figure 6) (Griffin, et al., 2017). The prices of the lots vary, and are still unknown, however direct communication with brokers (if there is one) or landlords is the best way to determine costs.

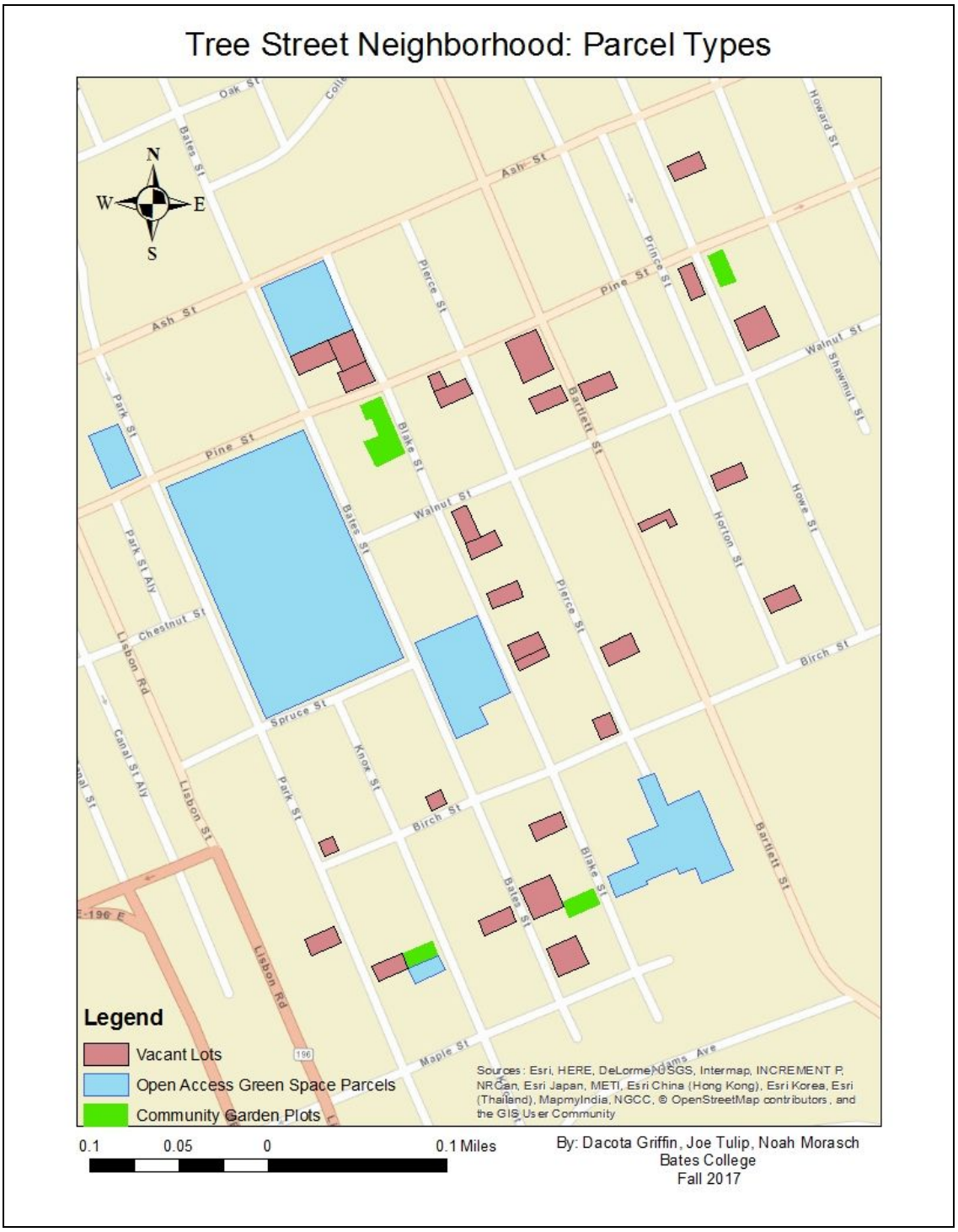

Figure 6 *A map of local vacant lots, open access green spaces, and community gardens. There are 29 vacant lots available for community or Bates owned garden space (Griffin et al., 2017)*

Ecosystem Services:
Converting vacant lots into community gardens through this program has the potential for a variety of ecosystem services, including increased nutrient cycling, soil formation, the potential for cultural and recreational activities, plant pollination, food production, water regulation, and habitat for residential and migrating animal species (Costanza et al. 1997).

Social and Partnership Potential:
This project presents opportunities for many levels of extended engagement with the Lewiston/Auburn community. For one, this project would most likely be developed and maintained in collaboration with the St Mary's Nutrition Center and Lots to Gardens, a well-established Lewiston/Auburn community garden program. Furthermore, these gardens would allow Bates students/staff and Lewiston/Auburn residents to work with each other for many years to come.

Economic Benefits:
Residents would not receive direct economic benefits from this project, but they would likely receive goods in the form of increased access to fresh vegetables.

Educational Benefits:
A local garden project would provide educational opportunities for both Lewiston/Auburn residents and Bates students. There are educational summer programs for high school students that are run by staff at the St. Mary's Nutrition Center. The Nutrition Center also accepts Bates student interns every summer, some of whom aid in the youth summer program.

Window Dressers

Window Dressers is a Maine-based, nonprofit organization that is dedicated to assisting Maine residents in decreasing heat loss through windows in order to reduce GHG emissions, fuel consumption and heating costs (L. Season pers. comm. Oct. 13, 2017). They accomplish this goal by installing reusable thermal inserts on the inside of windows. Inserts consist of two layers bordering an interior dead space, and a foam edging, which together work to prevent air leaks and reduce heat loss. According to the Window Dressers website, these inserts are estimated to have an R factor, or resistance to conductive heat flow, close to 3. This is compared to single paned windows, which tend to have R factors of around 1. With these inserts, a "typical" Maine home containing ten windows could save about 1.3 tons CO_2e, 128 gallons (484.5 L) of heating oil, and $326 of heating costs in a single year (D. Mistro, 2015). As most Maine homes and

apartments contain more than 10 windows, many residents could expect to reduce a much greater amount of GHG emission and save a great deal more oil and energy.

The cornerstone of Window Dressers' program is a community build model, through which volunteers and community members put together their window inserts. This model works to bring Maine communities together around the issues of emissions and heating reductions, and helps to maintain low and reasonable insert costs for these communities. It also presents an opportunity for Bates students who have studied abroad to participate as volunteers. These students would not only have an opportunity to engage with Lewiston/Auburn residents, they would also see how money they likely provided through their study abroad fee was directly impacting others. The ability to actually see the offset program in action is very unlikely to happen with verified offset projects, which is one of the benefits of local projects such as Window Dressers.

In addition, Window Dressers has a well established program for low-income families who otherwise would not be able to afford such an option. This low-income boundary is not defined by Window Dressers. Each year, they donate 22% of their total inserts to those who "qualify" as low-income. If residents self-report as low-income or relate to staff members that they are unable to pay the full price of the Window Inserts, they are taken on their word and are included within the low-income program (L. Season pers. comm. Oct. 13, 2017). This system is much more inclusive than other energy systems, as it eliminates extensive paperwork that can be prohibitive to lower income residents seeking to improve the energy efficiency of their residence.

Bates has the ability to increase the number of windows set aside for those who qualify as low-income by using some of offset program funds budgeted for local projects to purchase window inserts. Specifically, Bates could set up a loan system in which the offset budget of the college pays the upfront costs of window inserts for Lewiston/Auburn residences and/or public facilities. In the following one or two years, the recipient of the window inserts pays back the loan with money saved from improved insulation. This loan may or may not have interest. At

this point, Bates would have no net loss and potentially a small net gain, while the recipient of the window inserts continues to save money on their heating bills (F. Eanes, pers. comm. Dec. 8, 2017) . This system is an excellent way to invest Bates' offset budget in the community with little risk, a short payback period, and many social co-benefits for Lewiston/Auburn residents.

Ecosystem Services:
At least at this moment, the Window Dressers program does not directly provide ecosystem services.

Social and Partnership Potential:
Especially if Bates students and Lewiston/Auburn residents were to participate together in the community build process, these two parties would most likely interact for the duration of the project. However, this project does have the potential to establish partnerships that extend beyond the initial community build process. The window inserts are removed at the end of each each winter, and reinstalled at the beginning of the following winter. The Window Dressers organization has observed that this removal and reinstallation process can create issues for the continuity of the program, as some residents may store the inserts and subsequently forget about them, while other may not have appropriate storage space. To remedy these issues, representatives from Window Dressers suggested that Bates could provide a space on campus to store window inserts, or that some students could create accountability among residents by sending a reminder email to those who have window inserts.

Economic Benefits:
This project provides a high degree of economic benefit to Lewiston/Auburn residents. For one, a former student's thesis found that residents with at least 10 window inserts could save around $326 off heating costs each year. Whether this money would be saved by landlords or homeowners, this is a significant reduction in a heating bill each year. Furthermore, as 10 inserts cost $250, they more than pay for themselves within that first year of use. It also has the potential to have a high degree of economic benefit for Bates. Many student houses, especially those on Frye Street, are not very energy efficient due to uninsulated windows and doors. If window inserts were installed in these houses through Window Dressers, Bates could save a lot of money off their annual heating bills and further reduce their GHG emissions.

Educational Benefits:
The community builds present an opportunity for Lewiston/Auburn residents to learn more about energy efficiency, and its potential to benefit them economically, environmentally and comfort-wise. The Window Dressers project as a whole also provides potential educational opportunities for Bates students in the form of independent research projects or internships. For example, students could research the economic and emissions impact of Lewiston/Auburn residences with installed window inserts.

Lewiston Treebate Program

This year, the city of Lewiston began their Treebate Program, which offers a stormwater fee rebate to residents who purchase plant select tree species on single-family and duplex properties. Applicants who qualify must plant deciduous, non-invasive trees that measure at least 1.5 inches in diameter at six inches above the surface of the soil, and send proof of payment and a photo to Lewiston's Arborist for verification (Lewiston Treebate Program, n.d.). Once deemed eligible, property owners will be credited 50% of the tree's cost for their stormwater fee. Up to $100 of this fee can be credited.

This program was proposed by Michael Lachance, the Lewiston Ward 7 City Councilor, due to the many benefits that urban trees offer to property owners and entire neighborhoods (Storm Offer Rebate, 2017). Not only do trees improve the aesthetics of a city and provide greenspace, but they also provide many recognized ecosystem services. These include filtration of air pollution, noise reduction and rainwater management (Bolund & Hunhammar, 1999). Increasingly, urban tree programs are also being promoted for providing carbon sequestration through tree biomass and urban soils (Nowak & Crane, 2002). However, due to the short lifespan of urban trees and urban management practices such as leaf removal and dead tree removal, which differ from those practiced in forests, it is unlikely that trees actually sequester as much as they have been said to. Further research into the emission reduction potential of urban tree programs would need to be conducted before the Lewiston Treebate Program was utilized for carbon sequestration ang GHG emission reductions.

Ecosystem Services:
Urban trees provide a wide range of documented ecosystem services, including potential carbon sequestration through tree biomass and urban soils, water regulation, atmospheric gas regulation, and habitat for residential and migrating animal species (Constanza et al. 1997).

Social and Partnership Potential:
Depending on the methods by which this project is implemented, there are several ways in which Bates and Lewiston residents could interact for this project. If trees purchased by Bates were planted through community planting sessions, Bates students and Lewiston residents would engage with each other throughout each session. If the actual tree planting process is a physical challenge for residents, Bates students could assist them by planting the trees for these residents. In this scenario, the degree of interaction between residents and students would depend on a number of factors, such as whether the Lewiston residents were present for the tree planting.

Economic Benefits:
If the cost of eligible trees is prohibitive to Lewiston residents, Bates could use a portion of the offset program funds allocated towards local projects to purchase trees. Under this scenario, residents would directly benefit financially, as they would not have to purchase trees.

Educational Benefits:
This project has the potential for educational partnerships with Bates, such as through student independent research or internships. For example, the degree to which urban trees can sequester carbon is dependent upon a number of variables, including soil type, soil compaction, tree species, and climate. An internship or independent study could be conducted on the sequestration potential of this project.

3.7 Local Project Valuation Results

As outlined in Table 4, each of the three local projects considered within this report were scored according to the metric for local projects detailed within our methods.

	Local Garden	Treebate Program	Window Dressers
Education			
Economic			
Social/ Partnership			
Ecosystem Services			

Table 4 *Unweighted scores for the three local projects according to the four variables for the local project metrics*

The local garden projects and Window Dressers scored a 2 for education, as they have the potential to provide educational opportunities for both Bates students and Lewiston/Auburn residents. The Treebate Program was given a 1 for education because at this moment, it just has the potential for educational partnerships with Bates through student independent research or internships. This score could be increased to a 2 if environmental education opportunities were built into the Treebate Program.

Both the Window Dressers and Treebate programs have the potential to provide direct monetary benefits to Lewiston and/or Auburn residents, so they were given scores of 1. The local gardens program does not have the potential to provide direct monetary benefits to Lewiston/Auburn residents, so it was given a score of 0.

The local garden project would exist in collaboration with St. Mary's Nutrition Center and Lots to Gardens, and would establish partnerships between Bates students and Lewiston/Auburn residents that would extend beyond the duration of the project itself. Accordingly, local gardens were given a score of 2 for the social/partnership variable. The Window Dressers and Treebate programs would most likely establish relationships between Bates students and Lewiston and/or Auburn residents lasting solely for the duration of each project, so they were both given scores of 1 for the social/partnership variable.

Both the local garden and Treebate Programs would provide a variety of ecosystem services to Lewiston and/or Auburn, so they were both given a score of 1 for ecosystem services. Window Dressers does not provide any obvious ecosystem services, and was thus given a score of 0 for ecosystem services. Again, these scores were ultimately recorded as a fraction of the total possible points for each metric.

We did not weigh certain variables of the local projects metric over others according to different priorities, as we did with the verified projects, which is illustrated in Figure 7 below. Until the

local projects can officially count as offsets, their expected impact pertains more to the co-benefits they would provide to both Bates and the Lewiston/Auburn community, as opposed to overall climate impact. Accordingly, at least at this moment in time, each of these projects will mainly be evaluated for the degree to which they can benefit both Bates and Lewiston/Auburn. This does not mean that the climate impact of these projects will not be addressed. To even be a part of the Bates offset program, each of these projects must contribute to climate mitigation and emissions reductions in some capacity.

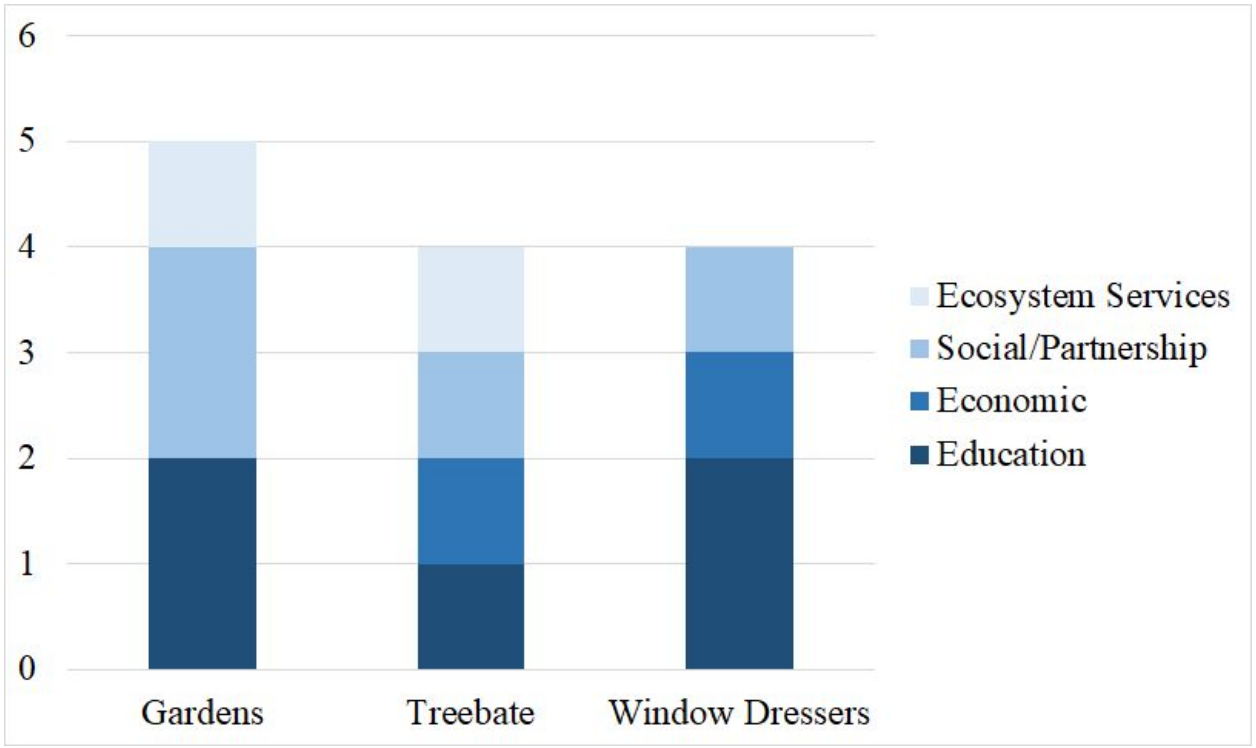

Figure 7 *Rankings for each of the three local projects according to the four metrics described above.*

Even though the local projects were given an unweighted score, Figure 7 above allows us to compare the overall environmental and co-benefit impact of each project. All of the projects fell within a similar range, which demonstrates that they all have the potential to be beneficial for both Bates and Lewiston/Auburn.

Even though it does not provide direct monetary benefits to Lewiston/Auburn residents, the local gardens project was just slightly the highest overall scoring project, due to its high educational and partnership potential. The Treebate and Window Dressers programs received the same overall score. While the Treebate Program would provide elements of all four of the considered variables, Window Dressers scored high for educational potential, but did not receive a score for ecosystem services.

3.8 Funding Sources

The budget for the Bates study abroad offset program changes slightly each academic year, as it would be scaled according to the number of students studying abroad each year, the locations to which they travel, and the funding sources available.

To hold students accountable for their personal study abroad emissions, we recommend that a small percentage of the Bates off-campus study fee be put towards an offset program fund. With the exception of the Fall Semester Abroad, Associated Kyoto Program, and Short Term Abroad programs, all Bates students who study abroad must pay 7% of each semester's regular tuition, in addition to their abroad program fees (Center for Global Education, n.d.). For the 2017 - 2018 academic year, this fee is $2,335 per student per semester, thus students studying abroad for the full year must pay it twice, once for each semester. Since we cannot predict how many students will study abroad for a full academic year, we did not include this double payment in our calculations, however it should be considered when an offset program is ultimately chosen.

Currently, the study abroad fee goes directly towards the Center for Global Education, and funds academic and informational support to students before, during and after off-campus study. However, both Tina Mangieri and David Das agree that students should be held accountable for their own emissions, and believe that part of the off-campus study fee should also support a Bates offset program for study abroad related emissions (T. Mangieri & D. Das. pers. comm. Nov. 28, 2017). After reflecting on their own budgets, they suggested that 2 - 3% of the study

abroad fee could likely be put towards offset projects each year as a steady source of funding (see Figure 8 for detailed calculations).

Funding for an offset program could also come from savings associated with on campus energy efficiency projects, such as replacing light bulbs, improving insulation, and expanding use of renewable fuel oil. These funds will not exceed $10,000 and will likely be closer to $5,000 although exact numbers are not yet certain (T. Twist, pers. comm. Nov 14, 2017). Total funds can either go directly toward an offset project or they can be put toward an internal revolving fund that pays for future on-campus projects, a program similar to The University of New England's Green Revolving Fund (Bola, 2017). Funding from these savings would most likely be variable, as they would depend upon the needs of the Office of Sustainability each academic year. As Figure 4 illustrates, study abroad-related emissions are just one subset of many off-campus emissions that the Office of Sustainability will need to address in the coming years.

3.9 Budget Recommendations

Based upon consultations with Tom Twist and Shanna Cox, we strongly recommend allocating 50% of the final offset program budget towards third party verified projects, 25% towards local projects, and the remaining 25% towards on-campus, educational, or internship projects. This budget scheme would allow Bates to completely offset all study abroad related emissions, thus moving the college closer to its goal of carbon neutrality. Furthermore, by investing 25% percent of funds each year in both on-campus environmental education, research and internship opportunities and in sustainable development within the Lewiston/Auburn community, Bates would uphold its commitment to the ACUPCC and its own Mission Statement and CAP.

Proposed Budget Calculations
Off campus study fee $= \$2,335$ (*current academic year*) *Number of students who study abroad each year* ≈ 250 *With these figures, we calculate the annual funds collected through the study abroad fee,* $250 * \$2,335 = \$583,750$ *per academic year* *We recommend that 2% or 3% of this fee be put toward carbon offsets. This would result in the following annual budgets,* $2\% \rightarrow 0.02 * \$583,750 = \$11,675$ $3\% \rightarrow 0.03 * \$583,750 = \$17,512$

Figure 8 *Calculations for proposed student financial input scenarios.*

Under the 50-25-25 budget breakdown, the proposed 2% scenario would offset roughly 530 metric tons of CO_2e through verified offset protocols, while the 3% scenario would offset 796 metric tons of CO_2e. The annual target is roughly 700 metric tons; although the total for the 2016-2017 academic year was 691 metric tons of CO_2e, we want to account for annual fluctuations and other associated flight emissions that were not accounted for in this methodology. The first budget scenario (2%) does not offset all required emissions, thus the Office of Sustainability would need to contribute the remaining portion, about $5,000. The scenario that is ultimately chosen will depend on the future budget of the Office of Sustainability and the portion of the study abroad fee that gets approved for travel offsets.

4. RECOMMENDATIONS AND NEXT STEPS

Based upon our research into voluntary offset programs and our consultations with Tom Twist, Shanna Cox, we have several recommendations for how this project should move from this proposal and towards a tangible offset program through collaboration with the Bates Office of Sustainability, the Center for Global Education and spokespeople from Lewiston/Auburn.

As we've outlined throughout this report and in the accompanying literature review, we strongly recommend that local and on-campus projects be prioritized and included within a Bates study abroad emissions offset program. For one, this would ensure that Bates would meet the offset program standard set by the ACUPCC guidelines. Additionally, the prioritization of local and on-campus projects would also uphold and further Bates' commitment to engagement outside of the campus, as emphasized in the college's Mission Statement, and would also meet the expectations set within the 2010 Bates Climate Action Plan. Even though these projects would not officially count towards Bates's emissions reductions and path towards carbon neutrality, investment into local projects at this moment in time could increase the future likelihood of these projects counting as offsets.

Budget-wise, we also firmly recommend setting aside 2 - 3% of the Bates off-campus study fee for a Bates study abroad offset program, depending on the degree to which the Office of Sustainability can also provide funding support. As outlined within the Budget Recommendations, a budget of this size would allow Bates to offset the current "toeprint" emissions total stemming from study abroad travel, and would allow for investment into local and on-campus projects.

One of the most important next steps for this project is further, and more complete, quantification of Bates study abroad travel emissions. The GHG emissions totals included within this report have been categorized as carbon "toeprints" instead of footprints, as they only cover student travel to and from their host countries, and an initial quantification of emissions related

to airport transportation. To move these totals closer to a footprint figure, emissions stemming from student travel while abroad and emissions resulting from Bates Fall Semester Abroad (FSA) and Associated Kyoto Program (AKP) must also be accounted for and quantified. To address travel while abroad, we recommend sending out a survey to students who studied abroad during the 2016 - 2017 academic year to gain insight into the degree to which students travel while abroad, as well as the methods of transportation that students use. To increase the number of survey responses, all respondents could be entered into a raffle for a prize of some sort. To incorporate emissions stemming from the FSA and AKP programs, GHG emissions totals should be calculated for prior academic years. The emissions totals calculated for this report were from the 2016 - 2017 academic year, and the FSA and AKP programs were not offered during that period of time. Quantification of prior academic years would also provide insight into the variability of GHG emissions year by year, depending on the off-campus study programs offered each year.

Likewise, to hold all students who study abroad accountable for their emissions, the financial means by which students who study abroad through the FSA, AKP or Short Term Abroad programs should be further considered. Students who participate in these programs do not pay the off-campus study fee, which makes the possibility of their financial contribution to an offset program more complicated. Instead, those who study abroad through the FSA or AKP programs directly pay Bates their full tuition for that semester, while those who participate in Short Term Abroad programs pay an additional fee directly to the academic department.

Another future step for this project would be incorporating greater environmental awareness into overall Bates study abroad experience. Before students study abroad, they attend a mandatory pre-departure orientation to receive essential information prior to leaving Bates. If sustainability information was included in these orientations sessions, they could be an opportunity to get students thinking about how they can be sustainable off campus and in another country. Once students return from abroad, they could be required to engage with some of the local projects included within the offset program to see the local impact of their portion of the offset budget.

This could look like participating in a Lewiston/Auburn community build for Window Dressers or spending a day in one of the local gardens with Lots to Gardens.

Finally, an important future step for a Bates offset project would be increased collaboration with peer institutions, especially on a simplified and more financially viable verification process for local projects. Both Duke and College of the Atlantic are frustrated with the barriers that the current standard verification process presents for incorporating localized projects into their offset programs. In response to this issue, Duke is working on developing a peer verification process through which colleges and universities would verify each other's local offsets. Such a system would allow local projects to meet the standard set by internationally-recognized carbon offset registries, without the high price demanded by independent auditors, and thus create further engagement between institutions and their surrounding communities. Several other colleges and universities, including College of the Atlantic, have expressed a keen interest in such a program, and it would be in the best interest of Bates to provide Duke with feedback to maximize the potential impact of a peer institutional verification process at the college.

Caitlin and Sarah both work as Eco-Representatives for Tom Twist and the Office of Sustainability, and will thus continue to be involved with this project during the 2018 Winter Semester. As a member of the Carbon Data subgroup, Caitlin in particular will be focused on further quantifying and tracking the college's Scope III emissions. In collaboration with Geoff Swift, Tom Twist, Tina Mangieri, and David Das, we plan on finalizing a budget within the coming months and choosing one or several programs to invest in. We urge the college to act on our suggestions in order to reach its goal of carbon neutrality by 2020 while simultaneously investing in local initiatives to continue acting as a leader in community engagement.

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APPENDIX A

Detailed calculations for Bates study abroad emissions are available below.

Fall 2016 Emissions Calculations

Destination	Total Miles	# students	Total	CO2 coefficient	CH4 coefficient	N20 coefficient		CO2 in Kg	CH4 in Kg	N2O in Kg	Metric Tons
Buenos Aires, Argentina	10723.00	1	10723.00	0.191	0.0008	0.0060		2048.093	0.0085784	0.064338	
Melbourne, Australia	21039.48	2	42078.96	0.191	0.0008	0.0060		8037.081	0.033663168	0.25247376	
Sydney, Australia	20186.00	1	20186.00	0.191	0.0008	0.0060		3855.526	0.0161488	0.121116	
Thimphu, Bhutan	14977.00	2	29954.00	0.191	0.0008	0.0060		5721.214	0.0239632	0.179724	
Valparaiso, Chile	10443.00	3	31329.00	0.191	0.0008	0.0060		5983.839	0.0250632	0.187974	
Shanghai, China	14627.68	2	29255.36	0.191	0.0008	0.0060		5587.774	0.023404288	0.17553216	
Kunming	15563.00	1	15563.00	0.191	0.0008	0.0060		2972.533	0.0124504	0.093378	
Havana, Cuba	2829.00	1	2829.00	0.162	0.0008	0.0052		458.298	0.0022632	0.0147108	
Prague, Czech Republic	7803.00	8	62424.00	0.191	0.0008	0.0060		11922.984	0.0499392	0.374544	
Copenhagen, Denmark	7367.00	23	169441.00	0.191	0.0008	0.0060		32363.231	0.1355528	1.016646	
Quito, Ecuador	5959.00	1	5959.00	0.191	0.0008	0.0060		1138.169	0.0047672	0.035754	
Paris, France	6936.00	1	6936.00	0.191	0.0008	0.0060		1324.776	0.0055488	0.041616	
Berlin, Germany	7613.00	2	15226.00	0.191	0.0008	0.0060		2908.166	0.0121808	0.091356	
Freiburg, Germany	7328.00	1	7328.00	0.191	0.0008	0.0060		1399.648	0.0058624	0.043968	
Athens, Greece	9536.00	1	9536.00	0.191	0.0008	0.0060		1821.376	0.0076288	0.057216	
Budapest, Hungary	8434.00	2	16868.00	0.191	0.0008	0.0060		3221.788	0.0134944	0.101208	
Reykjavik, Iceland	4940.00	2	9880.00	0.191	0.0008	0.0060		1887.080	0.007904	0.05928	
Delhi, India	14325.34	3	42976.02	0.191	0.0008	0.0060		8208.420	0.034380816	0.25785612	
Dublin, Ireland	6043.94	3	18131.82	0.191	0.0008	0.0060		3463.178	0.014505456	0.10879092	
Rome, Italy	8247.00	24	197928.00	0.191	0.0008	0.0060		37804.248	0.1583424	1.187568	
Kyoto, Japan	13780.36	3	41341.08	0.191	0.0008	0.0060		7896.146	0.033072864	0.24804648	
Fort Dauphin, Madagascar	17076.00	1	17076.00	0.191	0.0008	0.0060		3261.516	0.0136608	0.102456	
Rabat, Morocco	6914.00	1	6914.00	0.191	0.0008	0.0060		1320.574	0.0055312	0.041484	
Windhoek, Namibia	14355.00	1	14355.00	0.191	0.0008	0.0060		2741.805	0.011484	0.08613	
Kathmandu, Nepal	14817.00	3	44451.00	0.191	0.0008	0.0060		8490.141	0.0355608	0.266706	
Amsterdam, Netherlands	6939.00	2	13878.00	0.191	0.0008	0.0060		2650.698	0.0111024	0.083268	
Dunedin, New Zealand	18954.00	5	94770.00	0.191	0.0008	0.0060		18101.070	0.075816	0.56862	
Wellington, New Zealand	18260.00	1	18260.00	0.191	0.0008	0.0060		3487.660	0.014608	0.10956	
Lisbon, Portugal	6374.16	1	6374.16	0.191	0.0008	0.0060		1217.465	0.005099328	0.03824496	
Cape Town, South Africa	15438.00	3	46314.00	0.191	0.0008	0.0060		8845.974	0.0370512	0.277884	
Alicante, Spain	7238.00	1	7238.00	0.191	0.0008	0.0060		1382.458	0.0057904	0.043428	
Madrid, Spain	6891.00	3	20673.00	0.191	0.0008	0.0060		3948.543	0.0165384	0.124038	
Valencia, Spain	7166.00	3	21498.00	0.191	0.0008	0.0060		4106.118	0.0171984	0.128988	
Stockholm, Sweden	7562.00	2	15124.00	0.191	0.0008	0.0060		2888.684	0.0120992	0.090744	
Providenciales, Turks and Ca	2852.00	1	2852.00	0.162	0.0008	0.0052		407.836	0.0022816	0.0148304	
Kampala, Uganda	14135.56	1	14135.56	0.191	0.0008	0.0060		2360.545	0.011308448	0.08481336	
London, UK	6575.00	2	13150.00	0.191	0.0008	0.0060		2511.650	0.01052	0.0789	
Edinburgh, UK	6211.00	12	74532.00	0.191	0.0008	0.0060		14235.612	0.0596256	0.447192	
Multi-Country (Cities)	30083.09	1	30083.09	0.191	0.0008	0.0060		5745.870	0.024066472	0.18049854	
Multi-Country (Human Righ	22883.00	1	22883.00	0.191	0.0008	0.0060		4370.653	0.0183064	0.137298	
		132									
							Sum (kg)	242098.440	1.016	7.618	
			1270454.05				CO2e	242098.440	25.409081	2270.217491	244.3940662

Winter 2017 Emissions Calculations

Destination	Total Miles	# students	Total	CO2 coefficient	CH4 coefficient	N20 coefficient		CO2 in Kg	CH4 in Kg	N2O in Kg	Metric Tons
Buenos Aires, Argentina	10723.00	4	42892.00	0.191	0.0008	0.0060		8192.372	0.0343136	0.257352	
Brisbane, Australia	19427.00	2	38854.00	0.191	0.0008	0.0060		7421.114	0.0310832	0.233124	
Hobart, Australia	20978.00	1	20978.00	0.191	0.0008	0.0060		4006.798	0.0167824	0.125868	
Sydney, Australia	20186.00	2	40372.00	0.191	0.0008	0.0060		7711.052	0.0322976	0.242232	
Townsville, Australia	19436.00	1	19436.00	0.191	0.0008	0.0060		3712.276	0.0155488	0.116616	
Vienna, Austria	8113.00	1	8113.00	0.191	0.0008	0.0060		1549.583	0.0064904	0.048678	
Belgrade, Serbia	8711.00	1	8711.00	0.191	0.0008	0.0060		1663.801	0.0069688	0.052266	
Thimphu, Bhutan	14977.00	1	14977.00	0.191	0.0008	0.0060		2860.607	0.0119816	0.089862	
Cochabamba, Bolivia	9090.00	2	18180.00	0.191	0.0008	0.0060		3472.380	0.014544	0.10908	
Valparaiso, Chile	10443.00	2	20886.00	0.191	0.0008	0.0060		3989.226	0.0167088	0.125316	
Taipei, Taiwan	15450.00	1	15450.00	0.191	0.0008	0.0060		2950.950	0.01236	0.0927	
Kunming, China	15563.00	1	15563.00	0.191	0.0008	0.0060		2972.533	0.0124504	0.093378	
Hong Kong	15960.00	1	15960.00	0.191	0.0008	0.0060		3048.360	0.012768	0.09576	
Havana, Cuba	2829.00	2	5658.00	0.162	0.0008	0.0052		916.596	0.0045264	0.0294216	
Prague, Czech Republic	7803.00	10	78030.00	0.191	0.0008	0.0060		14903.730	0.062424	0.46818	
Copenhagen, Denmark	7367.00	16	117872.00	0.191	0.0008	0.0060		22513.552	0.0942976	0.707232	
Quito, Ecuador	5959.00	1	5959.00	0.191	0.0008	0.0060		1138.169	0.0047672	0.035754	
Paris, France	6936.00	9	62424.00	0.191	0.0008	0.0060		11922.984	0.0499392	0.374544	
Berlin, Germany	7613.00	1	7613.00	0.191	0.0008	0.0060		1454.083	0.0060904	0.045678	
Freiburg, Germany	7328.00	1	7328.00	0.191	0.0008	0.0060		1399.648	0.0058624	0.043968	
Munich, Germany	7678.00	1	7678.00	0.191	0.0008	0.0060		1466.498	0.0061424	0.046068	
Athens, Greece	9536.00	2	19072.00	0.191	0.0008	0.0060		3642.752	0.0152576	0.114432	
Reykjavik, Iceland	4940.00	1	4940.00	0.191	0.0008	0.0060		943.540	0.003952	0.02964	
Dublin, Ireland	6043.94	4	24175.76	0.191	0.0008	0.0060		4617.570	0.019340608	0.14505456	
Tel Aviv, Israel	11097.00	1	11097.00	0.191	0.0008	0.0060		2119.527	0.0088776	0.066582	
Rome, Italy	8247.00	17	140199.00	0.191	0.0008	0.0060		26778.009	0.1121592	0.841194	
Tokyo, Japan	13471.00	3	40413.00	0.191	0.0008	0.0060		7718.883	0.0323304	0.242478	
Amman, Jordan	11094.00	1	11094.00	0.191	0.0008	0.0060		2118.954	0.0088752	0.066564	
Merida, Mexico	3670.00	1	3670.00	0.162	0.0008	0.0052		594.540	0.002936	0.019084	
Windhoek, Namibia	14355.00	1	14355.00	0.191	0.0008	0.0060		2741.805	0.011484	0.08613	
Kathmandu, Nepal	14817.00	3	44451.00	0.191	0.0008	0.0060		8490.141	0.0355608	0.266706	
Amsterdam, Netherlands	6939.00	2	13878.00	0.191	0.0008	0.0060		2650.698	0.0111024	0.083268	
Dunedin, New Zealand	18954.00	6	113724.00	0.191	0.0008	0.0060		21721.284	0.0909792	0.682344	
Wellington, New Zealand	18260.00	1	18260.00	0.191	0.0008	0.0060		3487.660	0.014608	0.10956	
Krakow, Poland	8208.00	1	8208.00	0.191	0.0008	0.0060		1567.728	0.0065664	0.049248	
Cape Town, South Africa	15438.00	3	46314.00	0.191	0.0008	0.0060		8845.974	0.0370512	0.277884	
Alicante, Spain	7238.00	1	7238.00	0.191	0.0008	0.0060		1382.458	0.0057904	0.043428	
Madrid, Spain	6891.00	3	20673.00	0.191	0.0008	0.0060		3948.543	0.0165384	0.124038	
Valencia, Spain	7166.00	5	35830.00	0.191	0.0008	0.0060		6843.530	0.028664	0.21498	
Colombo, Sri Lanka	17227.00	2	34454.00	0.191	0.0008	0.0060		6580.714	0.0275632	0.206724	
Stockholm, Sweden	7562.00	2	15124.00	0.191	0.0008	0.0060		2888.684	0.0120992	0.090744	
London, UK	6575.00	10	65750.00	0.191	0.0008	0.0060		12558.250	0.0526	0.3945	
Edinburgh, UK	6211.00	8	49688.00	0.191	0.0008	0.0060		9490.408	0.0397504	0.298128	
Ho Chi Minh City, Vietnam	17608.00	1	17608.00	0.191	0.0008	0.0060		3363.128	0.0140864	0.105648	
Multi-Country (Cities)	24985.00	1	24985.00	0.191	0.0008	0.0060		4772.135	0.019988	0.14991	
Multi-Country (Human Righ	22883.00	1	22883.00	0.191	0.0008	0.0060		4370.653	0.0183064	0.137298	
Multi-Country (Health)	21282.00	4	85128.00	0.191	0.0008	0.0060		16259.448	0.0681024	0.510768	
		146									
							Sum (kg)	279763.328	1.172916608	8.78941216	
							CO2e	279763.328	29.3229152	2619.244824	282.4118959

Short Term 2017 Emissions Calculations

Destination	Total miles	# students	Total	CO2 coefficient	CH4 coefficient	N20 coefficient		CO2 in Kg	CH4 in Kg	N2O in Kg	Metric Tons
China	14753.19	16	236051.04	0.191	0.0008	0.0060		45085.749	0.188840832	1.41630624	
Ecuador	6211.48	16	99383.68	0.191	0.0008	0.0060		18982.283	0.079506944	0.59630208	
	1456.00	16	23296.00	0.162	0.0008	0.0052		3773.952	0.0186368	0.1211392	
Germany	7328.18	16	117250.88	0.191	0.0008	0.0060		22394.918	0.093800704	0.70350528	
Hungary	7557.29	22	166260.38	0.191	0.0008	0.0060		31755.733	0.133008304	0.99756228	
	554.68	22	12202.96	0.275	0.0091	0.0087		3355.814	0.111046936	0.106165752	
	390.59	22	8592.98	0.275	0.0091	0.0087		2363.070	0.078196118	0.074758926	
Alaska	4953.66	13	64397.58	0.191	0.0008	0.0060		12299.938	0.051518064	0.38638548	
	2852.48	13	37082.24	0.162	0.0008	0.0052		6007.323	0.029665792	0.192827648	
	654.00	13	8502.00	0.162	0.0008	0.0052		1377.324	0.0068016	0.0442104	
	134.00	13	1742.00	0.275	0.0091	0.0087		479.050	0.0158522	0.0151554	
		83									
							Sum (kg)	147875.152	0.806874294	4.654318686	
							CO2e	147875.152	20.17185735	1386.986968	149.2823112

Full Year (2016 - 2017) Emissions Calculations

Destination	Total Miles	# of Students	Total	CO2 coefficient	CH4 coefficient	N20 coefficient		CO2 in Kg	CH4 in Kg	N2O in Kg	Metric Tons
Paris	6936	1	6936	0.191	0.0008	0.006		1324.776	0.0055488	0.041616	
Kyoto	13780.36	1	13780.36	0.191	0.0008	0.006		2632.049	0.011024288	0.08268216	
London	6575	2	13150	0.191	0.0008	0.006		2511.650	0.01052	0.0789	
		4									
							Sum (kg)	6468.47476	0.027093088	0.20319816	
							CO2e	6468.47476	0.6773272	60.55305168	6.529705139

Staff Travel (2016-2017) Emissions Calculations

	Total Miles	CO2 coefficient	CH4 coefficient	N20 coefficient		CO2 in Kg	CH4 in Kg	N2O in Kg	Metric Tons
Site Visit 1									
	7328.18	0.191	0.0008	0.0060		1399.682	0.005862544	0.04396908	
	987.06	0.162	0.0008	0.0052		159.904	0.000789648	0.005132712	
	975.00	0.162	0.0008	0.0052		157.950	0.00078	0.00507	
	1366.00	0.162	0.0008	0.0052		221.292	0.0010928	0.0071032	
Site Visit 2	8247.00	0.191	0.0008	0.0060		1575.177	0.0065976	0.049482	
Site Visit 3									
	7367.00	0.191	0.0008	0.0060		1407.097	0.0058936	0.044202	
	685.36	0.162	0.0008	0.0052		111.028	0.000548288	0.003563872	
Site Visit 4									
	537.32	0.275	0.0091	0.0083		147.763	0.004889612	0.004459756	
	13392.00	0.191	0.0008	0.0052		2557.872	0.0107136	0.0696384	
	4420.00	0.162	0.0008	0.0047		716.040	0.003536	0.020774	
					Sum (kg)	8453.805	0.040703692	0.25339502	
					CO2e	8453.805	1.0175923	75.51171596	8.530334728